In-situ and Ex-situ Analysis of Battery Cathode Materials

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Advances in electrochemical energy storage are critical and may be a key factor in the ability to fully utilize renewable energy sources such as wind, hydroelectric, and geothermal power. Additionally, transportation, aerospace, personal electronics and biomedical applications have ever increasing demands for portable power. Despite remarkable advances in the optimization of electrochemically active materials over the last several decades, there remains an urgent need to enhance utilization efficiencies and to develop materials that can safely deliver high power and energy densities.

We are pursuing the investigation of bimetallic materials capable of redox initiated in-situ generation of conductive nano-particles by reduction displacement reactions. The self-generation of conductive networks allows more efficient electrode design by minimizing the need for the addition of inert conductive additives. We have been able to demonstrate that poorly conductive phosphate materials, such as $Ag_2VO_2PO_4$, increase conductivity by 15,000X on the initiation of the reduction reaction. Spectroscopic techniques for the analysis of the negative electrode surfaces will be presented and related to battery performance. The electrochemistry of the $MM'PO_4$ family will be discussed as well as possible applications for batteries utilizing cathodes with these materials.